ENVIRONMENTAL SENSITIVITY INDEX: W. PENINSULAR FLORIDA 2

INTRODUCTION

Environmental Sensitivity Index (ESI) maps have been developed for the shoreline of West Peninsular Florida (Volume 2) to encompass the coastal areas from Sarasota Bay to Cape Sable, Florida. The ESI maps include information for three main components: shoreline habitats; sensitive biological resources; and human-use resources. Background information, as well as the methods of data collection and presentation, are summarized in the following sections.

SHORELINE HABITAT MAPPING

The intertidal habitats of West Peninsular Florida (Volume 2) were mapped during overflights conducted in June 1993. The aerial surveys were conducted using fixed-wing aircraft, flying at elevations of 300-500 feet and slow air speed. An experienced coastal geologist updated the intertidal habitats directly onto the same 1:24,000 scale U.S. Geological Survey (USGS) topographic maps that were used during the original shoreline mapping project in 1982. Where appropriate, multiple habitats were delineated for each shoreline segment. Relatively simple changes to the shoreline position and shape were made during the overflights. Where there were complex changes in the shoreline, the most current aerial photographs were used to update the shoreline and habitats on the topographic maps, particularly where new canals and marinas were built.

Prediction of the behavior and persistence of oil on intertidal habitats is based on an understanding of the dynamics of the coastal environments, not just the substrate type and grain size. The sensitivity of a particular intertidal habitat is an integration of the following factors:

1) Shoreline type (substrate, grain size, tidal elevation, origin)
2) Exposure to wave and tidal energy
3) Biological productivity and sensitivity
4) Ease of cleanup

All of these factors are used to determine the relative sensitivity of intertidal habitats. Key to the sensitivity ranking is an understanding of the relationships between: physical processes, substrate, shoreline type, product type, fate and effect, and sediment transport patterns. The intensity of energy expended upon a shoreline by wave action, tidal currents, and river currents directly affects the persistence of stranded oil. The need for shoreline cleanup activities is determined, in part, by the slowness of natural processes in removal of oil stranded on the shoreline.

These concepts have been used in the development of the ESI, which ranks shoreline environments as to their relative sensitivity to oil spills, potential biological injury, and ease of cleanup. Generally speaking, areas exposed to high levels of physical energy, such as wave action and tidal currents, and low biological activity rank low on the scale, whereas sheltered areas with associated high biological activity have the highest ranking. The list below includes the shoreline habitats delineated for the entire coastline of Florida, presented in order of increasing sensitivity to spilled oil.

1) Exposed Vertical Rocky Shores / Seawalls
2) Exposed Rocky Platforms
3) Fine-grained Sand Beaches
4) Coarse-grained Sand Beaches
5) Mixed Sand and Gravel Beaches / Fill
6) Gravel Beaches / Riprap
7) Exposed Tidal Flats
8) Sheltered Rocky Shores / Seawalls / Vegetated Banks
9) Sheltered Tidal Flats
10A) Exposed Marshes and / or Mangroves
10E) Sheltered Marshes and / or Mangroves

Each of the shoreline habitats are described on pages 6-10, in terms of their physical description, predicted oil behavior, and response considerations.

SENSITIVE BIOLOGICAL RESOURCES

A marine and coastal biologist with Research Planning, Inc. (RPI) compiled the biological information presented on the maps with the assistance of state and regional biologists and resource managers from the Florida Department of Environmental Protection (FDEP) and other agencies. Bird and terrestrial mammal point data were provided by the Florida Game and Fresh Water Fish Commission (FGFWFC) and the Florida Natural Areas Inventory (FNAI). Information collected and depicted on the maps denotes the key biological resources that are most likely at risk in the event of an oil spill. Six major categories of biological resources were considered during production of the maps: birds, habitats, marine mammals, reptiles, shellfish, and terrestrial mammals.

Spatial distribution of the species on the maps is represented by polygons, lines, and points, as appropriate. Associated with each of these representations is an icon depicting the types of biological resources that are present. Species have been divided into groups and subgroups, based on their behavior and taxonomic classification. The icons reflect this grouping scheme. The groups are color coded, and the subgroups are represented by different icons as follows:

The polygon, line, or point color and pattern are the same for all the animals in one group (i.e., birds). When there is more than one group of animals in one polygon, the polygon is then assigned the multigroup color and pattern. Also associated with each biological polygon, line, or point feature on the map is a number (located under the icon). This number references a table on the reverse side of the map with a complete list of species found in the polygon as well as seasonality and life-history information on each species.

There are some species that are found throughout specific geographical areas or habitat types. Displaying the polygons for these species would cover large areas, making the maps very difficult to read. Thus, species which occur over the majority of certain geographic areas or habitats are often identified in a small box which states that they are “COMMON IN ...”, (e.g., Common in Offshore Area). This approach informs the user of the presence of these species, while maintaining readability of the map. In all instances, data for species listed as “Common in ...” exist as polygons in the digital coverages. The use of “Common in ...” is implemented on a map per map basis, depending on the size, location, and number of polygons present.

For many biological resources, information and expert knowledge may not be available for all geographic locations. For this reason, absence of a resource on a map does not necessarily mean it is not present. Under the descriptions of the various biological resource groups, the geographical limits of available knowledge or the survey boundaries of particular studies are given when known.

MARINE MAMMALS

Manatees are the only marine mammals included in the West Peninsular Volume 2 atlas. Bottlenose dolphins are not depicted on the maps due to widespread abundance and an assumed low sensitivity to oil spills. Dolphins are likely to be present throughout the study area, in both estuarine and nearshore waters of the Gulf of Mexico. An emergency contact for bottlenose dolphins in West Peninsular Florida is the National Marine Fisheries Service, Protected Species Management Branch, 813 / 570-5312.

West Indian manatees in West Peninsular Florida are present throughout all inshore and nearshore waters of the Gulf of Mexico. However, only known concentration areas are depicted on the maps. These concentration areas are often associated with estuaries, rivers, and wintering or cold-weather aggregation sites. When feeding, manatees may also concentrate in areas with seagrasses or other aquatic vegetation. In addition to direct oil spill vulnerability, spill responders (boat operators in particular) should be aware of manatee concentration areas in order to avoid collisions which could injure or kill manatees. Emergency contacts for manatees in West Peninsular Florida are the Florida Marine Patrol, 800 / DIAL-FMP, and the FDEP Marine Mammal Pathobiology Laboratory, 813 / 893-2904.

Marine mammal (manatee) distributions are displayed on the maps as a brown hatch polygon. However, if species in addition to

marine mammals are included in the polygon, a black hatch (multigroup) polygon is used. A brown icon with a manatee silhouette is used to indicate the presence of manatees. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. The next column provides an estimate of the concentration of the species at the site. Concentration is indicated as "VERY HIGH", "HIGH", "MED", or "LOW". These estimates are subjective, based on local expert opinion on the relative concentrations in the area. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The final columns denote time-periods for sensitive lifehistory stages or activities. For many species there is a temporal shift in seasonality with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

TERRESTRIAL MAMMALS

Terrestrial mammals included in the West Peninsular Volume 2 atlas are limited to the threatened Southern mink. However, river otter, mink, raccoon, and other small, semi-aquatic, fur-bearing mammals are likely to occur in and around nearly all inshore water bodies, especially where rivers, streams, and wetlands are present. Small fur-bearing mammals can be severely impacted by swimming through oil slicks or coming into contact with oiled wetland vegetation. An emergency contact for terrestrial mammals in West Peninsular Florida is the Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Hazardous Spill Coordinator, 904/921-5982.

Terrestrial mammal sites are shown as point locations using a brown dot. A brown icon with a small mammal silhouette is used to indicate the presence of terrestrial mammals. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. The next column provides an estimate of the concentration of species at this site. For terrestrial mammals, counts of individuals at each site are listed in the concentration column. Where counts were not available, the concentration column was left blank. Even though concentration may not be listed, it should be recognized that the number of individuals or the importance of the site was still significant enough to be included in observation or occurrence databases maintained by FGFWFC and FNAI. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. For many species there is a temporal shift in seasonality with spatial changes in location. Temporal information included in the tables is specific to the one point that it references.

BIRDS

Birds are divided into several species subgroups based on behavior and taxonomy. The species table lists all the birds included on the maps, sorted by subgroup. These species were included either because of their likelihood of impact by an oil spill or special protection status as threatened or endangered. Emergency contacts for birds in West Peninsular Florida are the Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Hazardous Spill Coordinator, 904/921-5982, and the Florida Game and Fresh Water Fish Commission, Waterfowl Management Section, 904/488-5878.

Bird distributions are shown on the maps as polygons with a green hatch pattern. Special bird concentration sites, such as nesting sites, shorebird wintering/migratory sites, and protected species locations, are displayed as point locations using a green dot. For polygon and point data, a green icon with the appropriate bird silhouette (diving bird, waterfowl, etc.) is used to indicate the presence of birds. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either state (S) or federal (F) lists. The next column provides an estimate of the concentration of each species at the site. For bird polygon data, concentration is usually indicated as "HIGH", "MED", or "LOW". These concentration estimates are subjective, based on local expert opinion on relative concentrations in the area. For bird point data originating from FGFWFC, the highest count of individuals recorded at each site is given. Where counts were not available, the concentration column was left blank. For bird nesting data originating from Everglades National Park staff, the number of nests is given, or a relative nesting concentration is given. Even though concentration may not be listed for some records, it should be recognized that the number of individuals or the importance of the site was still significant enough to be included in observation or occurrence databases maintained by FGFWFC and FNAI. The species seasonality is shown in the next twelve columns representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The last column denotes the nesting season for each species, if nesting occurs in an area or at a site. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

REPTILES

Reptiles depicted in the West Peninsular Volume 2 atlas include sea turtles and the American crocodile. American alligators are not depicted on the maps due to widespread abundance and an assumed low sensitivity to oil spills. Alligators are likely to be present in all freshwater areas, especially those associated with marshes and swamps. Alligators may also be present in estuarine areas where access to freshwater is locally available. For more information on American alligators, contact the Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, 352/955-2230.

Two types of sea turtle areas are depicted, in-water habitats and nesting beaches. The in-water areas represent known foraging, developmental, migratory, or other habitat areas where sea turtles are likely to occur in substantial numbers. Information on in-water distributions of marine turtles is extremely limited, and the data portrayed on the maps reflect this partial knowledge. All marine turtles listed in the species list can occur throughout the coastal waters of West Peninsular Florida. Nesting beaches include sand beach areas where sea turtles come ashore to nest. Nesting beaches indicated on the maps correspond closely to beaches surveyed during the 1994 nesting season. Not all potential nesting beaches are surveyed; thus, lack of nesting polygons does not necessarily represent absence of sea turtle nesting. It should be noted that in addition to direct oiling, sea turtle adults, nests, and young may also be at risk from response activities and equipment. Beach cleanup operations and heavy machinery can disturb both adult and hatchling turtles, as well as their nests. Ruts left on the beach by heavy equipment can entrap hatchlings trying to get to the water, resulting in death from exposure or predation. Hatchlings may also be killed by entrapment behind booms placed to protect the shoreline. Flood lights used for night operations or security could disorient adult turtles or hatchlings, causing them to move towards oiled areas or roads. Expert or emergency contacts for sea turtles in West Peninsular Florida are the Florida Marine Research Institute (FDEP), 813/896-8626 during business hours, or 813/582-0481 (FDEP emergency beeper) during non-business hours.

American crocodile concentration and nesting areas are depicted on the maps. American crocodiles occur mainly in mangrove swamps and associated estuarine rivers, bays, lakes, etc. Nesting sites are located above the vegetation line along beaches, river banks, and canal levees. Nest sites may be returned to and used over many years. Nests typically consist of a mound of soil in which the female digs a hole and deposits 20-50 eggs (Moler, 1992). American crocodiles are listed as endangered, and have a very restricted distribution in southern Florida, the northern limit of their range. Due to their restricted distribution and generally low numbers, American crocodiles are at risk from impacts to individual animals or their mangrove habitat. Expert contacts for American crocodiles in West Peninsular Florida are Dr. Frank Mazzotti, University of Florida, 305/370-3725, and the Florida Game and Fresh Water Fish Commission, Wildlife Research Laboratory, 352/955-2230.

Reptile distributions are depicted as polygons with a red hatch pattern. If species in addition to reptiles are included in a polygon, a black hatch (multigroup) pattern is used. A red icon with a turtle or crocodile silhouette is used to indicate the presence of reptiles. The number under the icon references a table on the reverse side of the map. In the tables, the first column gives the species name. The second column denotes whether the species has been designated as endangered (E) or threatened (T) on state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at a site. Concentration is indicated as "HIGH", "MED", or "LOW". For crocodiles, concentration may also be listed as "TRANSIENT", indicating areas crocodiles move through when traveling between known resident concentration areas. Resident concentrations and/or nest sites may occur within areas indicated as "transient", although they are not known due to lack of intensive surveys. For both in-water sea turtle distributions and crocodiles, concentration estimates are subjective, based on local expert opinion. For sea turtle nesting beaches, concentrations are based on nesting densities recorded during surveys coordinated and permitted by FDEP or Everglades National Park. Each species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The last three columns indicate nesting, hatching, and internesting time periods. Nesting refers to the time when female turtles or crocodiles construct nests and deposit eggs. Hatching refers to the time when young are hatching and emerging from the nests. Internesting refers to the time prior to and during nesting when adult male and female sea turtles are concentrated in nearshore waters. Mating may also be occurring at this time. Though not indicated by the turtle nesting beach polygons, internesting/mating concentrations along the outer coast are likely to occur within 2-3 kilometers of the shoreline. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon that it references.

SHELLFISH

Shellfish included in the West Peninsular Volume 2 atlas include crustaceans and mollusks. The species table lists all the shellfish shown on the maps, sorted by subgroup. Commercially or recreationally important species are included. For oysters, quahog (hard clams), and bay scallops, known concentration and/or harvest areas are mainly limited to the vicinity of Charlotte Harbor and the associated bays and sounds. Absence of oysters, quahog, or scallops on maps for other areas does not necessarily indicate that these resources are not present. An expert contact for oysters and clams in southwest Florida is the South Gulf Coast District Shellfish Office (FDEP) in Murdock, 914/255-0083. Expert contacts for clams and scallops are: Florida Marine Research Institute (FDEP), 813/896-8626, or Dr. N. Blake (University of South Florida), 813/893-9521. An expert contact for crustaceans is the Florida Marine Research Institute (FDEP), 813/896-8626.

The distributions of shellfish are shown as polygons with an orange hatch pattern. If species in addition to shellfish are included in the polygon, a black hatch (multigroup) pattern is used. Orange icons are associated with the polygons, and the silhouette of the subgroup is shown. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. No shellfish have such designations. The next column provides an estimate of the concentration of species at the site. Concentration is indicated as "HIGH", "MED", or "LOW". These estimates are subjective based on local expert opinion on the relative concentrations in the area. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at a location in a particular month, an "X" is placed in the month column. The last three columns indicate dates for spawning, mating, and the presence of juveniles. Spawning refers to the release of gametes to the water column during reproductive periods, or the mass release of larvae. Mating applies to shellfish which form temporary reproductive pairs for fertilization of gametes (e.g., blue crabs), with later release of more developed larval young. For many species there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon that it references.

HABITATS

Submerged habitats included in the West Peninsular Volume 2 atlas are limited to seagrass beds. Seagrasses in Florida consist of monospecific or mixed beds of shoal grass (*Halodule wrightii*), manatee grass (*Syringodium filiforme*), and turtle grass (*Thalassia testudinum*). Less common seagrasses may include *Halophila* spp. and widgeon grass (*Ruppia maritima*). *Halophila* spp. may be more likely to occur in deeper waters. Widgeon grass may most often be found in low-salinity areas, although it can also occur in hypersaline waters. Intertidal seagrass beds are at greatest risk from floating oil. Intertidal seagrass beds typically contain shoal grass and/or widgeon grass. For most oil spills, the abundant animals associated with seagrass habitats are often at greater risk than the vegetation. An expert contact for seagrasses in West Peninsular Florida is the Florida Marine Research Institute (FDEP), 813/896-8626.

Seagrasses are shown as polygons with a purple hatch pattern. Icons are not associated with the seagrass polygons. Purple icons with a submerged plant silhouette are used in a limited number of cases where seagrasses are indicated as "COMMON IN AREA". Seagrasses in Florida are present all year. However, during winter months above-ground vegetation may be reduced or not present.

HUMAN-USE FEATURES

The human-use features depicted on the maps are those which could be impacted by an oil spill or could provide access for response operations. All the features are represented by icons indicating the type of human-use resource.

Airport—Location of airfields or airports whether they are manned or unmanned. The locations were obtained from visual observations during the overflights or from USGS 1:24,000 topographic maps.

Archaeological/historic site—Location of archaeological and/or historical sites in close proximity to the shoreline or coastal wetland areas. This information was gathered from the Florida Master Site File, maintained by the Bureau of Archaeological Research, Florida Department of State. Site information was collected and compiled as polygons. These polygons may contain single sites or several sites, and may encompass larger archaeological or historic districts. The exact location of these sites are not represented on the maps due to their sensitivity to disturbance. Instead, generalized locations are depicted to indicate single or multiple site presence in the general vicinity. For more specific locational information, information on the type of site(s) present, and guidance during response operations, contact the Florida Site File Supervisor, 904/487-2299.

Boat ramp—Location of boat ramps. This information was gathered from 1993 overflight observations and from local expert sources.

Coast Guard—Location of Coast Guard facilities. This information was obtained from USGS 1:24,000 topographic maps.

Dive site—Location of recreational dive sites. These sites were identified using DeLoach (1993), the location of dive boat mooring buoys, and overflight surveys of dive boat contrations conduted by FDEP and The Nature Conservancy. It should be noted that most of the waters of South Florida are considered recreational diving areas, espcially the Florida Keys and the Florida Reef tract.

Marina—Location of marinas. This information was gathered from 1993 overflight observations and from local expert sources.

Marine sanctuary—Location of areas managed by the National Oceanic and Atmospheric Administration (NOAA) Sanctuaries and Reserves Division. These areas include national marine sanctuaries and national estuarine research reserves. Digitized boundaries were provided by FDEP.

National park—Location of areas managed by the National Park Service, including national parks, national seashores, and national monuments. Digitized boundaries were provided by the Geoplan Center, University of Florida, Department of Urban and Regional Planning.

State park—Location of areas managed by the FDEP Division of Recreation and Parks, including state parks, state recreation areas, state reserves, state preserves, etc. Digitized boundaries were provided by the Geoplan Center, University of Florida, Department of Urban and Regional Planning, and the FDEP office of Park Planning.

Recreational beach—Location of recreational beaches. Most sand beaches in Florida can be considered recreational beaches. Icons mainly designate beach locations where access, parking, and facilities are present. Locations of recreational beaches were determined using the Florida Atlas and Gazetteer (DeLorme Mapping, 1989) and local expert knowledge.

Reserve, preserve, refuge—Location of areas managed as national preserves, reserves, wildlife refuges, state areas not managed by the Division of Recreation and Parks, and private conservation lands. These areas include national wildlife refuges managed by the U.S. Fish and Wildlife Service, and state aquatic preserves and state reserves managed by the FDEP Bureau of Submerged Lands and Preserves, Division of State Lands. Digitized boundaries were provided by the Geoplan Center, University of Florida, Department of Urban and Regional Planning, and FDEP.

Water intake—Location of water intakes. The general locations of water intakes associated with coastal power plants were provided by B. Oven with the FDEP Power Plant Siting Group. Specific locations of water intakes were determined during telephone conversations with the plant managers or environmental/emergency response supervisors. Additional water intakes were indicated by local expert sources.

For aquaculture sites and water intakes, the name of the resource, the manager/owner, an emergency contact person, and a telephone number are provided. The information is listed on the reverse side of the maps, when available. The names and telephone numbers of various managed lands/waters are listed below.

NAME	TELEPHONE
MARINE SANCTUARIES/ESTUARINE RESERVES	
Rookery Bay National Estuarine Research Reserve	941/775-8845
NATIONAL PARK SERVICE LANDS	
Big Cypress National Preserve	941/695-2000
Everglades National Park	305/242-7700
NATIONAL WILDLIFE REFUGES	
Caloosahatchee National Wildlife Refuge	941/472-1100
Island Bay National Wildlife Refuge	941/472-1100
J.N. "Ding" Darling National Wildlife Refuge	941/472-1100
Matlacha Pass National Wildlife Refuge	941/472-1100
Pine Island National Wildlife Refuge	941/472-1100
Ten Thousand Islands National Wildlife Refuge	941/353-8442
STATE DIVISION OF RECREATION AND PARKS	
Cayo Costa State Park	941/964-0375
Collier-Seminole State Park	941/394-3397
Delnor-Wiggins Pass State Recreation Area	941/597-6196
Don Pedro Island State Recreation Area	941/964-0375
Fakahatchee Strand State Preserve	941/695-4593

NAME	TELEPHONE
STATE DIVISION OF RECREATION AND PARKS (continued)	
Gasparilla Island State Recreation Area	941/964-0375
Koreshan State Historic Site	941/992-0311
Lovers Key State Recreation Area	941/597-6196
Oscar Scherer State Park	941/483-5956
Port Charlotte Beach State Recreation Area	941/964-0375
STATE DIVISION OF LANDS, BUREAU OF SUBMERGED LANDS AND PRESERVES	
Cape Haze Aquatic Preserve	941/283-2424
Cape Romano-Ten Thousand Islands Aquatic Preserve	941/283-2424
Estero Bay Aquatic Preserve	941/283-2424
Gasparilla Sound-Charlotte Harbor Aquatic Preserve	941/283-2424
Lemon Bay Aquatic Preserve	941/283-2424
Matlacha Pass Aquatic Preserve	941/283-2424
Pine Island Sound Aquatic Preserve	941/283-2424
Rookery Bay Aquatic Preserve	941/283-2424

GEOGRAPHIC INFORMATION SYSTEM DATA

The entire atlas product is stored in digital form in a Geographic Information System (GIS). The information is stored as maps and associated databases. The format for the data varies depending on the type of information or features for which the data are being stored. The three major formats are shoreline habitat classification, biological resources, and human-use features.

Under separate cover are a complete data dictionary, metadata, and descriptive information for the digital data sets and maps that were used to create this atlas. Below is a brief synopsis of the information contained in the digital version. Please refer to the metadata report for full explanations of the data and its structure.

SHORELINE HABITAT CLASSIFICATION

The shoreline habitat classification is stored as lines and polygons with the data identifying the type of habitat. In many cases, a shoreline may have two or three different classifications. These multiple classifications are represented on the maps by double and triple symbols, and in the database by ESI#1/ESI#2 where ESI#1 is the landward-most classification and ESI#2 is the seaward-most classification.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as lines, points, or polygons. Associated with each map feature is a unique identification number which is linked to a series of databases that further identify the resources. The first data set consists of a list of the species and the concentration of each species. This dataset is then linked to a dataset that describes the life history of each species (temporal presence and reproductive times at month resolution) for the specified map feature. Other databases linked to the first data set are the species identification database, which includes common and scientific names for all species and their threatened or endangered status, and the sources database, which provides source metadata at the feature level. An additional database is associated with the sea turtle nesting beach polygons. This table includes a survey id#, the survey county, and the survey beach name. The survey id# identifies the survey type, with survey id# 1 indicating 1994 FDEP surveyed beaches, survey id# 2 indicating 1995 surveyed beaches, survey id# 3 indicating non-surveyed beaches with nesting information provided by an expert source, and survey id# 4 indicating pre-1994 surveyed beaches. The county and surveyed beach name correspond to fields in the FDEP Statewide Sea Turtle Nesting Database, allowing for future updating of nesting information. For survey id# 3 (expert source), "unsurveyed" is listed under the surveyed beach name.

HUMAN-USE FEATURES

Human-use features are represented as lines, points, polygons, or as marker icons describing the feature. In the digital file, feature locations are represented by lines, points, or polygons. When available, the resource name is included in the database. All metadata sources are documented at the feature level.

REFERENCES

Listed below are the major hardcopy reference materials used during this project. In some instances, reference materials were not directly used as source materials, but were instead used or interpreted by scientists or resource managers who provided expert knowledge or personal communication concerning resources depicted in the atlas.

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SPECIES LIST*

Common Name	Species Name
MAMMALS	
MARINE MAMMALS	
West Indian manatee	*Trichechus manatus*
TERRESTRIAL MAMMALS	
Southern mink	*Mustela vison mink*
BIRDS	
DIVING BIRDS	
American white pelican	*Pelecanus erythrorhynchos*
Anhinga	*Anhinga anhinga*
Brown pelican	*Pelecanus occidentalis*
Common loon	*Gavia immer*
Double-crested cormorant	*Phalacrocorax auritus*
GULLS AND TERNS	
Black skimmer	*Rynchops niger*
Caspian tern	*Sterna caspia*
Common tern	*Sterna hirundo*
Forster's tern	*Sterna fosteri*
Laughing gull	*Larus atricilla*
Least tern	*Sterna antillarum*
Ring-billed gull	*Larus delawarensis*
Roseate tern	*Sterna dougallii*
Royal tern	*Sterna maxima*
Sandwich tern	*Sterna sandvicensis*
PASSERINE BIRDS	
Florida scrub jay	*Aphelocoma coerulescens coerulescens*
White-crowned pigeon	*Columba leucocephala*
PELAGIC BIRDS	
Magnificent frigatebird	*Fregata magnificens*
Northern gannet	*Morus bassanus*
RAPTORS	
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
SHOREBIRDS	
American oystercatcher	*Haematopus palliatus*
Black-bellied plover	*Pluvialis squatarola*
Common snipe	*Gallinago gallinago*
Dowitcher	*Limnodromus spp.*
Dunlin	*Calidris alpina*
Greater yellowlegs	*Tringa melanaleuca*
Killdeer	*Charadrius vociferus*
Least sandpiper	*Calidris minutilla*
Lesser yellowlegs	*Tringa flavipes*
Lesser-golden plover	*Pluvialis dominica*
Long-billed curlew	*Numenius americanus*
Marbled godwit	*Limosa fedoa*
Peep	*Calidris spp.*
Piping plover	*Charadrius melodus*
Red knot	*Calidris canutus*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Semipalmated plover	*Charadrius semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*
Sharp-tailed sandpiper	*Calidris acuminata*
Short-billed dowitcher	*Limnodromus griseus*
Snowy plover	*Charadrius alexandrinus*
Solitary sandpiper	*Tringa solitaria*
Spotted sandpiper	*Actitis macularia*
Stilt sandpiper	*Calidris himantopus*
Western sandpiper	*Calidris marui*
Whimbrel	*Numenius phaeopus*
White-rumped sandpiper	*Calidris fusciollis*
Willet	*Catoptrophorus semipalmatus*
Wilson's plover	*Charadrius wilsonia*
WADING BIRDS	
Black-crowned night heron	*Nycticorax nycticorax*
Cattle egret	*Bubulcus ibis*
Great blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Green-backed heron	*Butorides striatus*
Little blue heron	*Egretta caerulea*
Reddish egret	*Egretta rufescens*
Roseate spoonbill	*Ajaia ajaja*
Snowy egret	*Egretta thula*
Tricolored heron	*Egretta tricolor*
White ibis	*Eudocimus albus*
Wood stork	*Mycteria americana*
Yellow-crowned night heron	*Nyctanassa violacea*

SPECIES LIST*

Common Name	Species Name
BIRDS (continued)	
WATERFOWL	
Blue-winged teal	*Anas discors*
Bufflehead	*Bucephala albeola*
Common moorhen	*Gallinula chloropus*
Lesser scaup	*Aythya affinis*
Mottled duck	*Anas fulrigula*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Red-breasted merganser	*Mergus serrator*
Redhead	*Aythya americana*
REPTILES	
CROCODILIAN	
American crocodile	*Crocodylus acutus*
TURTLES	
Green sea turtle	*Chelonia mydas*
Kemp's ridley sea turtle	*Lepidochelys kempii*
Loggerhead sea turtle	*Caretta caretta*
SHELLFISH	
BIVALVES	
American oyster (eastern)	*Crassostrea virginica*
Atlantic bay scallop	*Argopecten irradians*
Quahog spp. (hard clam)	*Mercenaria spp.*
CRABS	
Blue crab	*Callinectes sapidus*
Stone crab	*Menippe spp.*
LOBSTER	
Spiny lobster	*Panulirus argus*
SHRIMP	
Pink shrimp	*Penaeus duorarum*
HABITATS	
SEAGRASSES	
Seagrass	

* Threatened and endangered species are designated by underlining.

Shoreline Habitat Descriptions

EXPOSED VERTICAL ROCKY SHORES; EXPOSED SEAWALLS ESI = 1

DESCRIPTION

- Exposed rocky shores consist of vertical limestone bedrock.
- The structures are solid man-made structures such as seawalls, revetments, piers, and port facilities, mostly constructed of concrete.
- Often there is no exposed substrate at low tide, but multiple habitats are indicated if present.
- Seawalls are built to protect the shore from erosion by waves, boat wakes, and currents, and thus are exposed to rapid natural removal processes.
- Attached animals and plants can be quite high.

PREDICTED OIL BEHAVIOR

- Oil is held offshore by waves reflecting off the steep, hard surface in exposed settings.
- Oil readily adheres to the dry, rough rocky surfaces, but it does not adhere to wet substrates.
- The most resistant oil would remain as a patchy band at or above the high-tide line.

RESPONSE CONSIDERATIONS

- Cleanup is usually not required.
- High-pressure water spraying may be conducted to:
  - remove persistent oil in crevices;
  - improve aesthetics; or
  - prevent leaching of oil.

EXPOSED ROCKY PLATFORMS ESI = 2

DESCRIPTION

- These are intertidal areas of limestone bedrock with relatively flat platforms 15-500 feet wide.
- The platform surface is irregular and tide pools/crevices are common.
- There is usually a sharp drop-off at the seaward edge.
- Large accumulations of seagrass wrack often occur at high-tide line.
- Attached animals and plants can be high.

PREDICTED OIL BEHAVIOR

- Oil will accumulate in wrack and depressions in bedrock platforms at high-tide line.
- Light oils are rapidly removed by waves and tides.
- Tar balls and heavy oils tend to melt into crevices and depressions, persisting for longer periods.

RESPONSE CONSIDERATIONS

- Where the high-tide area is accessible, it may be feasible to manually remove heavy oil accumulations and oiled debris.
- Thick accumulations of persistent oils would require high-pressure flushing.

FINE-GRAINED SAND BEACHES ESI = 3

DESCRIPTION

- These beaches are generally flat and hard-packed.
- Though they are predominately fine sand, there is often a small amount of shell or shell hash.
- There can be heavy accumulations of wrack present, particularly in south Florida.
- They are heavily utilized by people, birds, and turtles.
- Upper beach fauna include ghost crabs and amphipods; lower beach fauna can be moderate, but highly variable.

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone.
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide.
- Maximum oil penetration is about 10 cm.
- Burial of oiled layers by clean sand within the first few weeks after a spill typically will be less than 30 cm.
- Organisms living in the beach may be killed by smothering or lethal oil concentrations in the interstitial water.
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas.

RESPONSE CONSIDERATIONS

- These beaches are among the easiest shoreline types to clean.
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore.
- Activity through both oiled and dune areas should be severely limited, to prevent contamination of clean areas.
- Manual cleanup, rather than road graders and front-end loaders, is advised to minimize the volume of sand removed from the shore and requiring disposal.
- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic.
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the upper intertidal zone can be effective along outer beaches.

COARSE-GRAINED SAND BEACHES ESI = 4

DESCRIPTION

- Ocean and Gulf beaches have relatively steep beach faces with wide, unvegetated upper beach.
- They are composed of quartz sand and carbonate sediments.
- The amount of wrack varies considerably.
- They are heavily utilized by people, birds, and turtles.

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone.
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide.
- Maximum oil penetration is about 20 cm.
- Burial of oiled layers by clean sand within the first few days after a spill typically will be up to 50 cm.
- Organisms living in the beach may be killed by smothering or lethal oil concentrations in the interstitial water.
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas.

RESPONSE CONSIDERATIONS

- Coarse sand sediments are less trafficable, increasing the risk of mixing oil into the substrate by foot and vehicular traffic.
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore.
- Activity through both oiled and dune areas should be severely limited, to prevent contamination of clean areas.
- Manual cleanup, rather than road graders and front-end loaders, is advised to minimize the volume of sand removed from the shore and requiring disposal.
- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic.
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the upper intertidal zone can be effective along outer beaches.

MIXED SAND AND GRAVEL (SHELL) BEACHES/FILL ESI = 5

DESCRIPTION

- These beaches are composed of a poorly sorted mixture of sand, riprap, and/or shell fragments.
- Fill can be very hard packed with more mobile surface sediment, whereas natural beaches can be quite soft.
- They can occur in both high and low wave energy settings.
- Toe of beach generally composed of coarser, better sorted sediment.
- Because of sediment desiccation and mobility on exposed beaches, densities of animals and plants are lower than on sand beaches.

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited along and above the high-tide swash.
- Large spills will spread across the entire intertidal area.
- Oil penetration into shelly zones may be up to 50 cm; however, in general oil behavior is much like on a sand beach. Penetration into fill will be limited.
- Burial of oil will only occur on natural beaches, following wave events.
- Oil can be stranded in the coarse sediments on the lower part of the beach, particularly if the oil is weathered or emulsified.

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil from the upper beachface should be removed quickly to prevent penetration into the porous sediments.
- All oiled debris should be removed.
- Sediment removal should be limited as much as possible.
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the upper intertidal zone can be effective along outer beaches.
- In-place tilling may be used to reach deeply buried oil layers in the middle zone on exposed beaches, as an alternative to sediment removal.

GRAVEL (SHELL) BEACHES/RIPRAP ESI = 6

DESCRIPTION

- This shoreline type is essentially boulder-sized riprap.
- Riprap boulders are irregular in size, shape, and composition, though the surface is usually very rough.
- Riprap structures are placed for shoreline protection and inlet stabilization.
- Attached biota on the riprap can be moderate.

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the boulders is likely.
- Oil adheres readily to the rough surfaces.
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens.

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from between the riprap.
- All oiled debris should be removed.
- Low- to high-pressure flushing can be effective, making sure to recover all released oil.
- It may be necessary to remove and replace heavily oiled riprap.

EXPOSED TIDAL FLATS ESI = 7

DESCRIPTION

- Exposed tidal flats are broad intertidal areas composed primarily of sand and minor amounts of shell and mud.
- The presence of sand indicates that tidal currents and waves are strong enough to mobilize the sediments.
- They are usually associated with another shoreline type on the landward side of the flat, though they can occur as separate shoals.
- They can be sparsely to heavily vegetated by seagrasses.
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and use by foraging fish.

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of exposed tidal flats, but rather moves across the flat and accumulates at the high-tide line.
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy.
- Heavy, weathered oil can coat exposed seagrass vegetation and tarballs can be deposited in the seagrass beds.
- Oil does not penetrate water-saturated sediments.
- Biological damage may be severe, primarily to epifauna on seagrasses and infauna, thereby reducing food sources for birds and other predators.

RESPONSE CONSIDERATIONS

- Currents and waves can be very effective in natural removal of the oil.
- Cleanup is very difficult (and possible only during low tides).
- The use of heavy machinery should be restricted to prevent mixing of oil into the sediments.

SHELTERED ROCKY SHORES/SEAWALLS, VEGETATED BANKS, SOLID MAN-MADE STRUCTURES ESI = 8

DESCRIPTION

- Sheltered rocky shores are uncommon, except in south Florida, where they occur on the bay side of the Keys.
- They are very narrow, vertical scarps in limestone bedrock.
- The structures are solid man-made structures such as seawalls, groins, revetments, piers, and port facilities.
- Most structures are constructed of concrete, though wood or metal is also used.
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present.
- Most of the structures are designed to protect a single lot, thus their composition, design, and condition are highly variable.
- Attached animal and plant life can be dense.

PREDICTED OIL BEHAVIOR

- Oil will adhere readily to the rough surface, particularly along the high-tide line, forming a distinct oil band.
- The lower intertidal zone usually stays wet (particularly if algae covered), preventing oil from adhering to the surface.

RESPONSE CONSIDERATIONS

- Cleanup of seawalls is usually conducted for aesthetic reasons or to prevent leaching of oil.
- Low- to high-pressure spraying at ambient water temperatures is most effective when the oil is fresh.

SHELTERED TIDAL FLATS — ESI = 9

DESCRIPTION

- Sheltered tidal flats are composed primarily of mud with minor amounts of sand and shell.
- They are present in calm-water habitats, sheltered from major wave activity, and are frequently fronted by marshes or mangroves.
- The sediments are very soft and cannot support even light foot traffic in many areas.
- They can be sparsely to heavily covered with algae and/or seagrasses.
- They can have very heavy wrack deposits along the upper fringe.
- There can be large populations of shellfish, worms, and snails.
- They are heavily utilized by birds for feeding.

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of sheltered tidal flats, but rather moves across the flat and accumulates at the high-tide line.
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy.
- Oil will not penetrate the water-saturated sediments, but could penetrate burrows and mud cracked sediments.
- In areas of high suspended sediments, sorption of oil can result in deposition of contaminated sediments on the flats.
- Biological damage may be severe.

RESPONSE CONSIDERATIONS

- These are high-priority areas necessitating the use of spill protection devices to limit oil-spill impact; deflection or sorbent booms and open water skimmers should be used.
- Cleanup of the flat surface is very difficult because of the soft substrate and many methods may be restricted.
- Low-pressure flushing and deployment of sorbents from shallow-draft boats may be helpful.

EXPOSED AND SHELTERED MARSHES — ESI = 10A/B

DESCRIPTION

- Marshes are intertidal wetlands containing emergent, herbaceous vegetation.
- Width of the marsh can vary widely, from a narrow fringe to extensive areas.
- Sediments range from sand to muds to organic peat.
- Exposed areas are located along bays with wide fetches and along heavily trafficked waterways.
- Sheltered areas are not exposed to significant wave or boat wake activity.
- Resident flora and fauna are abundant with numerous species with high utilization by birds.

PREDICTED OIL BEHAVIOR

- Oil adheres readily to intertidal vegetation.
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation. There may be multiple bands.
- Large slicks will persist through multiple tidal cycles and coat the entire stem from the high-tide line to the base.
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper, to the limit of tidal influence.
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or in burrows.
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to one meter).

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Natural removal processes and rates should be evaluated prior to conducting cleanup.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.
- Cleanup activities should be carefully supervised to avoid vegetation damage.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.

EXPOSED AND SHELTERED MANGROVES ESI = 10A/B

DESCRIPTION

- Red, black, and white mangroves dominate the intertidal forest of Florida.
- The roots and trunks are intertidal, with only the lowest leaves inundated by high tide.
- The width of the forest can range from one tree, to many miles.
- The substrate can be sand, mud, leaf litter, or peat, often as a veneer over bedrock.
- Wrack accumulations can be very heavy.
- They are highly productive, serve as nursery habitat, and support a great diversity and abundance of animal and plant species.

PREDICTED OIL BEHAVIOR

- Oil can wash through mangroves if oil comes ashore at high tide.
- If there is a berm or shoreline present, oil tends to concentrate and penetrate into the berm sediments or accumulated wrack/ litter.
- Heavy and emulsified oil can be trapped in thickets of red mangrove prop roots.
- Oil readily adheres to prop roots, tree trunks, and preumatophores.
- Reoiling from resuspended or released oil residues may cause additional injury over time.
- Oiled trees start to show evidence of effects (leaf yellowing) weeks after oiling; tree mortality may take months, especially for heavy oils.

RESPONSE CONSIDERATIONS

- Oiled wrack can be removed once the threat of oiling has passed. Wrack can actually protect the trees from oiling.
- Sorbent boom can be placed in front of oiled forests to recover oil released naturally.
- In most cases, no other cleanup activities are recommended.
- Where thick oil accumulations are not being naturally removed, low-pressure flushing or vacuum may be attempted at the outer fringe.
- No attempt should be made to clean interior mangroves, except where access to the oil is possible from terrestrial areas.
- It is extremely important to prevent disturbance of the substrate by foot traffic; thus most activities should be conducted from boats.